

**Amendments to the Drawings:**

The attached drawing sheets include one set of replacement drawings for Figures 1, 2a and 2b. New Figure 2c has been added. Details of the amendments are provided in the remarks/arguments section of this paper.

Attachments:                          Replacement Sheets  
    New Sheet – Figure 2c  
    Annotated Sheets Showing Changes

## REMARKS/ARGUMENTS

This is in response to the office action of July 13, 2005.

### Objections to Drawings

In paragraph 1 of the Office Action, the Examiner took the position that a number of features of the invention as specified in the claims should be added to the drawings. In particular, the Examiner stated that "the plurality of primary channels", "a splitter", "second channels", "a plurality of instrumentation amplifiers", an analog multiplexer", "a first analog to digital converter", "a voltage data bus", "a current amplifier", "an analog and digital control", "a computing device", and "a plurality of differential amplifiers" must be shown in the drawings or, alternatively, such features could be cancelled from the claims.

In addition, the Examiner objected to Figure 1 on the basis that it did not include short descriptive labels for the blank boxes.

### Objections to Claims

The Examiner rejected claims 1 to 5, 7, 15 to 22 and 26 as being anticipated by U.S. Patent No. 6,519,539 (Freeman et al.). Additionally, the Examiner rejected the remaining claims as being obvious in view of the teachings of Freeman et al. when combined with the teachings of one or more of U.S. Patent Numbers 6,239,579 (Dunn et al.); 4,916,734 (Stader et al.); and, 5,416,416 (Bisher).

### Response to Objections to Drawings

In response to the Examiner's objections to Figure 1, descriptive labels have been added to the formerly blank boxes of Figure 1. Support for these amendments can be found in paragraph 32 of the specification. In addition, Figure 1 has been amended to remove an equation, and a graph, formerly shown.

In response to the Examiner's objections to the drawings for failing to show features of aspects of the invention specified in the claims, Figure 2a has been amended to

show a current amplifier 111. Support for this amendment is provided by paragraphs 36, 45 and 46, which paragraphs have also been amended to include the reference numeral 111 with the term "current amplifier".

In addition to the above-described amendment, Figure 2a, as well as Figure 2b, have both been amended to add reference numeral 25, which designates the plurality of inputs. Support for this amendment is found in paragraph 11 and 35, as well as in claims 1 and 4 of the application as filed. Paragraphs 35 and 43 of the specification have also been amended to include reference numeral 25 to designate the "plurality of inputs".

Figure 2c has been added to illustrate features of the control device 30. In particular, as shown in Figure 2c, and as described in paragraph 35 of the specification, as well as elsewhere, the control device comprises a measuring portion 30a and a controlling portion 30b. Other elements of the control device are described below.

Paragraphs 35, 36, 40 and 43 have been amended to add reference numerals 30a and 30b to designate the measuring portion and controlling portion of the control device 30 respectively.

In paragraph 1 of the Office Action, the Examiner objected to the drawings for failing to show both the plurality of instrumentation amplifiers and the plurality of differential amplifiers. In fact, differential amplifiers are a particular type of instrumentation amplifiers, and to some extent these terms are used interchangeably throughout the specification. Figure 2c shows the differential amplifiers 31 connected to the plurality of inputs 25. Support for this amendment can be found in paragraphs 16 and 36 of the specification as filed, as well as in claim 22 of the application as filed.

As shown in Figure 2c, the differential amplifiers 31 are connected to a splitter 32 by primary channels 29. These primary channels are described in paragraphs 40 and 43 in the specification as filed, as well as in claims 8 and 10 of the application as filed. The splitter is described in paragraphs 40, 41 and 43 of the specification as

filed, as well as in claims 8 to 10 of the published application. As described, the splitter separates the DC and AC components of the voltages across each individual cell. The splitter is designating using reference numeral 32, which has been added to paragraphs 40, 41 and 43 of the specification as amended.

As shown in Figure 2c, and as described in paragraphs 40 and 43, claims 8 and 10, of the application documents as initially filed, the splitter 32 has first channels 27 for the DC components of the voltage across the individual cells. These first channels are designated using reference numeral 27 in Figure 2c and paragraphs 40 and 43 have been amended to include this reference numeral.

As shown in Figure 2c, splitter 32 also has second channels 28. The second channels receive the AC components of the voltage across the individual cells, and are described in paragraph 41 and claim 9 of the application as filed. Paragraph 41 of the specification has been amended to include reference numeral 28.

As described in paragraph 43 of the specification as originally filed, at least the first channels 27 are attached to an analog multiplexer. This analog multiplexer is shown in Figure 2c and is designated using reference numeral 44. Support for this amendment is found in paragraph 43 and claims 10, 11 and 23 of the application documents as filed. Paragraph 43 has been amended to designate the analog multiplexer using reference numeral 34. As shown in Figure 2c, the analog multiplexer 34 is connected to the controlling portion 30b of the control device 30 by multiplexer control line 41. Support for this amendment can be found in paragraph 43 and claim 10 of the application documents as initially filed. Paragraph 43 has been amended to include reference numeral 41 to designate the multiplexer control line.

As described in paragraph 44 of the specification as initially filed, an analog to digital converter is connected to the output of the analog multiplexer 34. Figure 2c shows this relationship. The analog to digital converter is designated using reference numeral 35. Support for this amendment can be found in paragraph 44 and claim 11

of the application documents as filed. Paragraph 44 has also been amended to add reference numeral 35.

As shown in Figure 2c, the analog to digital converter 35 is connected to the controlling portion 30b of the control device 30 by voltage data bus 37. Support for this amendment can be found in paragraph 44 and claim 11 of the application as filed. Paragraph 44 has been amended to include reference numeral 37 to designate the voltage data bus.

Analog to digital converter 35 is also connected to controlling portion 30b by an analog to digital control line 38, now shown in Figure 2c. Support for this amendment can be found in paragraph 44 of the specification, as well as in claim 11 of the application documents as originally filed.

Paragraph 48 of the specification as initially filed indicated that a computing device may be optionally connected to the controlling portion 30b. Claim 15 of the application as originally filed covered this feature. Figure 2c illustrates this relationship. Support for this amendment can be found in paragraph 48 and claim 15 of the application documents as originally filed.

Paragraph 48 has been amended to designate the computing device using reference numeral 39.

Based on the foregoing, it is respectfully submitted that the amendments to the drawings, including the addition of Figure 2c, does not add new matter to the present application.

#### **Response to Claim Rejections**

As discussed above, the Examiner rejected both claims 1 and 17 as anticipated by Freeman et al. According to the Examiner, Freeman et al. discloses all of the elements of claim 1, including a controller 50.

Freeman et al. describes a self-contained, portable apparatus for measuring the real and imaginary components of a fuel cell's complex impedance at discrete frequencies. Reference numeral 50 corresponds to a frequency synthesizer that is coupled to a load bank 100 for, as described beginning at line 42 of column 5, two purposes. First, the frequency synthesizer 50 produces a periodic AC waveform at a desired frequency. Second, the frequency synthesizer provides a DC offset, which is used to remotely program the load bank. The DC offset or control signal programs the load bank 100 to draw a desired, large DC current. The AC waveform or signal is superimposed on the DC current and is generally smaller.

As described in paragraph 39 of the specification as filed, using voltage and current signals obtained by the control device 30, the high frequency resistance of the fuel cell stack can be calculated in real time during actual use of the fuel cell. Any anomalies in this high frequency resistance can then either be reported to a fuel cell or automatically dealt with by the control system itself. The control device 30 may automatically deal with these anomalies by, for example, adjusting the temperature, humidity or reactant flow rates within the fuel cell system. Thus, the controller recited in claims 1 and 17 has a very different function from the frequency synthesizer described by Freeman et al.

To further distinguish these differences, claims 1 and 17 have been amended to specify that the at least one system operating condition controlled by the controller based on the voltage and current received from the measuring device is at least one of temperature, humidity, and reactant flow rates within the electrochemical system. Support for this amendment can be found at paragraph 39 of the specification. This feature is neither taught nor suggested by Freeman et al.

In addition, claims 16 and 26 have been amended to indicate that the current supply/draw means, is, at least in some embodiments, connected in parallel with the load. Support for this amendment of claims 16 and 26 can be found in paragraph 39 and Figures 2a and 2b of the specification as originally filed.

Based on the foregoing, it is respectfully submitted that claims 1 and 17 clear the prior art cited. Further, since the remaining claims depend either directly or indirectly from claims 1 and 17, it is respectfully submitted that these claims also clear the prior art cited.

**Miscellaneous Amendments**

In addition to the above-described amendments, other paragraphs of the specification have been amended for clarity. These amendments are described below.

Paragraph 2 has been amended to list the two half-cell reactions occurring at the two electrodes on different lines. Previously, both of these half-cell reactions had been shown on the same line.

Paragraphs 11 and 21 have been amended to conform to corresponding claims 1 and 17, as amended.

Paragraph 42 has been amended to correct spelling mistakes.

Paragraph 47 has been cancelled as this paragraph substantially repeated paragraph 45.

The Abstract has been amended to conform to amended claims 1 and 17.

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Amdt. Dated October 7, 2005  
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In view of the foregoing, favorable reconsideration and allowance of the application is respectfully requested.

Respectfully submitted,

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**Appendix for the Figures**

Annotated Sheets Showing Changes – Figure 1 Prior Art, Figure 2a and Figure 2b

Replacement Sheets – Figure 1 Prior Art, Figure 2a and Figure 2b

New Figure 2c

ANNOTATED SHEET  
SHOWING CHANGES

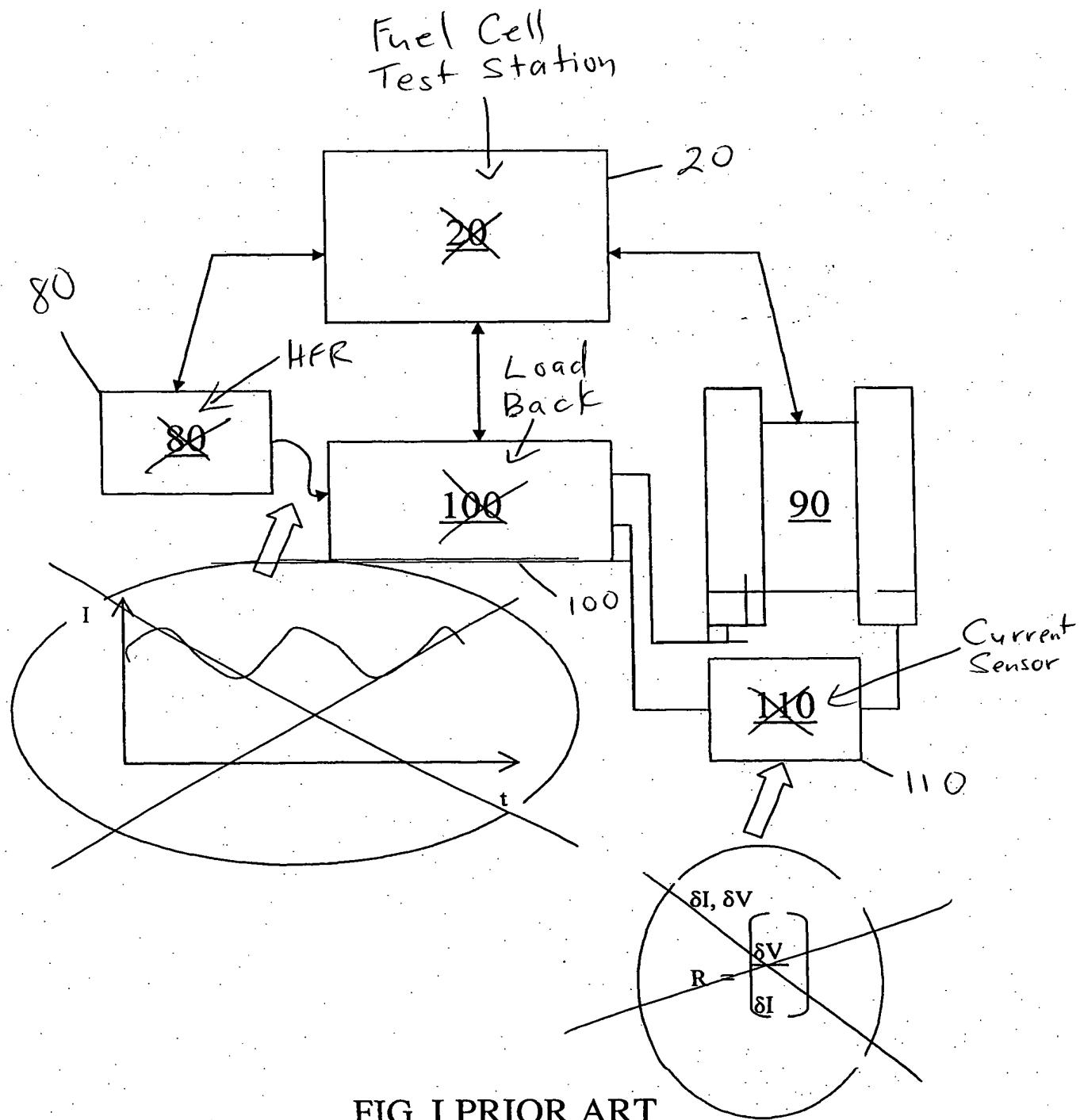


FIG. I PRIOR ART

ANNOTATED SHEET  
SHOWING CHANGES

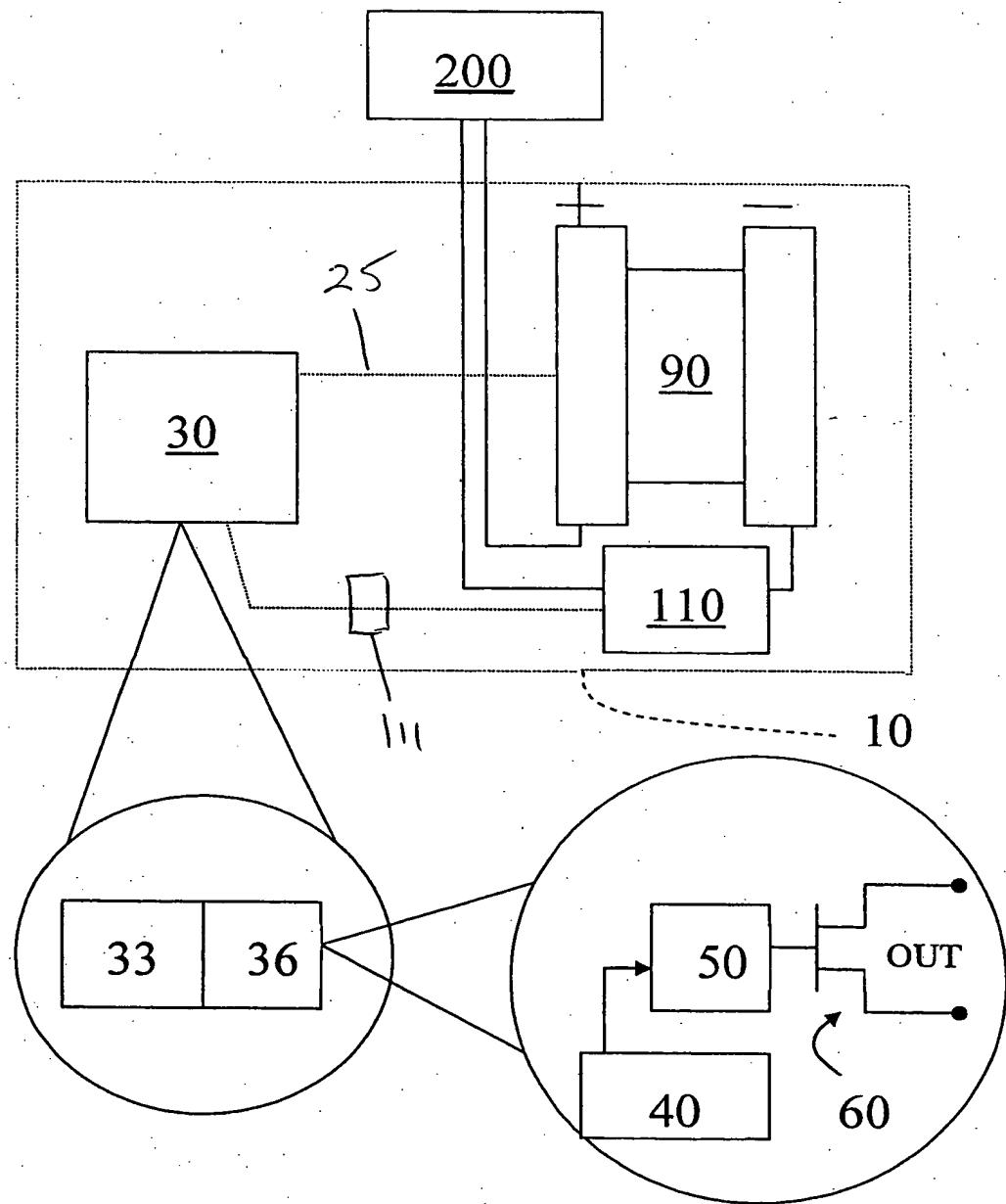


FIG. 2a

ANNOTATED SHEET  
SHOWING CHANGES

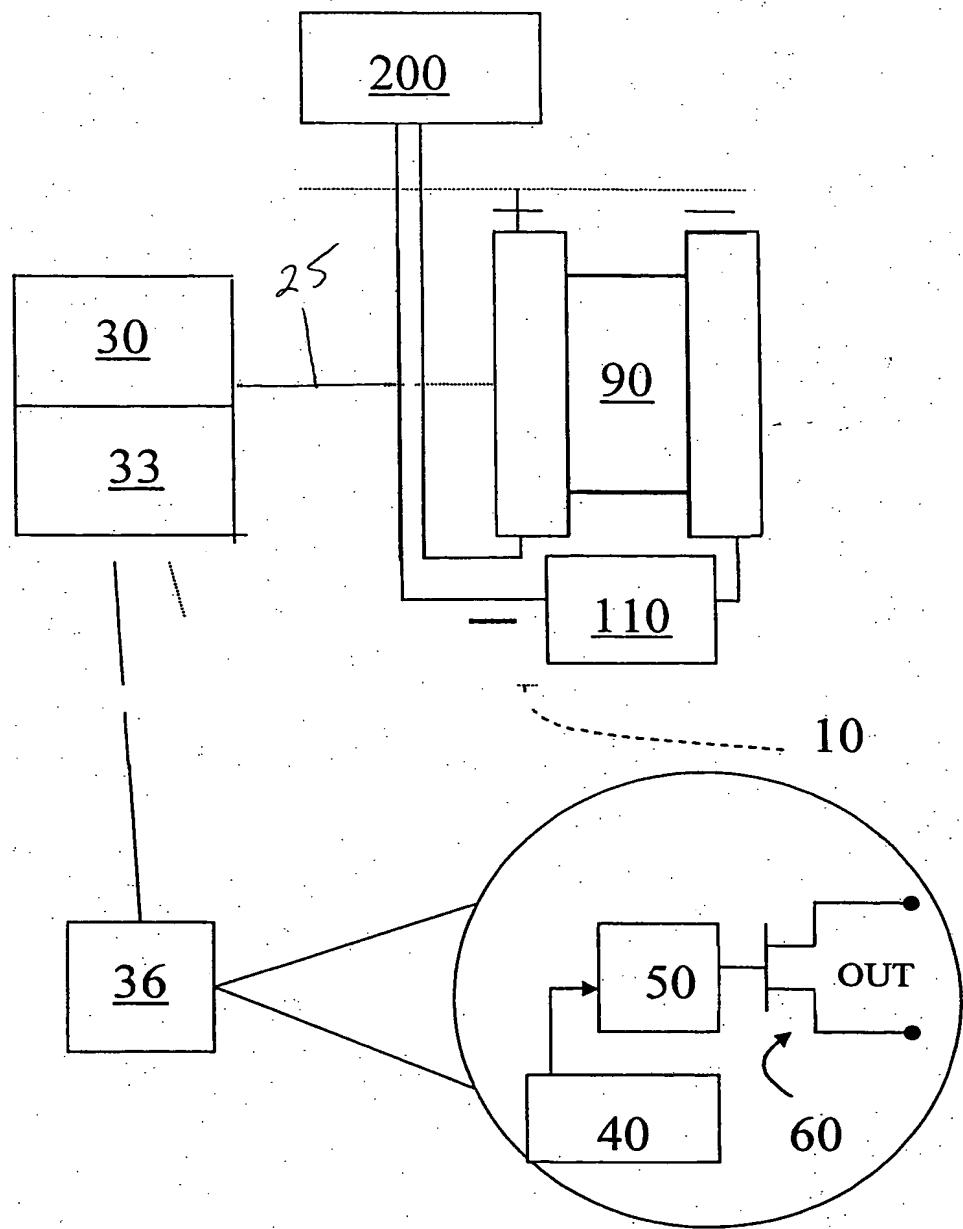


FIG. 2b